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14 May 1959

FROM : SUBJECT: Field Tests of RS-18 Equipment

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File RD-122 TO

1. On 22 April 1959, traveled from the Headquarters' area to the to conduct field tests of the RS-18 and other equipments. All transmissions were from the to the base station which was manned by . Equipments hand carried to the field for the test series included two RS-18s, one RS-6A, one AT-3, two KE-A/9 keyers and one KE-B/9 keyer. Appropriate ancillary equipments including a battery charger and test meter were included in the various packages.

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2. A total of forty transmissions from the various equipments was made during the test period. The individual results in the broad areas in which unsatisfactory performance was obtained are concluded to have been caused by the following:

a. Of 23 transmissions employing the RS-18 units, 18 were complete failures as far as reception by the Base is concerned. Four of these are attributed to an inoperative modulator module. Of the remaining 14, two of which were monitored by the NSA East Coast facility, although reported no reception, four are considered to have failed due to a combination of poor propagation and/or heavy interference. The remaining ten were unsuccessful due to either improper antenna tuning caused by ambiguous meter indications or by reasons unknown. Of the two successful transmissions, the text transmission accuracy averaged 95%. This figure includes any human error in recovering the transmitted information from the "Whirling Dirvish".

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b. Of 10 AT-3 transmissions, four were successfully received by the Base Station on 25 April. Four of the transmission failures are attributed to poor propagation conditions - WWV was transmitting the condition warning W5 during the transmission period on 24 April and the 25 mc band was observed to be quite dead. The remaining two unsuccessful transmissions were due to reasons unknown; these two transmissions occurred under the identical conditions as had the four successful transmissions but were timed 15 and 30 minutes later during the same day. Text transmission accuracy was 98% for the last 102 groups of a 135 group message. The first 33 groups were apparently garbled by a failure of the erase circuit to clear the tape of a previous message.

c. Of 6 KE-()/9 -AT-3 transmissions, all were received either QSA 4 or 7 by the Base Station. Although the Base Station frequency shift converter exhibited tendencies toward malfunctioning, the first KE-A/9 (#584) transmission was copied with an accuracy of 72%; during the two subsequent transmissions this keyer apparently malfunctioned with a copy accuracy of 17% and 8%. A fourth transmission employing KE-A/9 keyer #585 was copied with an accuracy of 84%. The sole FSK transmission copied by the Base had an accuracy of 86%. A re-run of the KE-9 keyer tests will be conducted to obtain more conclusive figures since the role played by the malfunctioning frequency shift converter in determining the final results has invalidated the test series.

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3. Observed weaknesses in the design and/or operation of the various equipments - together with suggestions for improvement - are contained in paragraphs 4, 5 and 6. We recommend this test series be repeated as soon as substantial corrective measures have been taken to improve the performance of the various units, particularly the RS-18. Prior to the next test series a simple absorption wavemeter preferably covering the tuning range 3 - 30 mcs without using a large number of coils should be constructed and made available for future field tests. This wavemeter should have a metered indication for relative power level indications. Such a separate power level indicating device should prove invaluable in future test series of equipments similar to the RS-18 and RS-16.

4. RS-18

a. The battery case should be altered to have captive slot headed screws similar to those used on AS-3 battery instead of the small easily lost phillips head type.

b. The present interconnection harness is considered to be a major disadvantage to the practical use of the RS-18 equipment. The numerous multi-conductor power connectors are easily damaged during insertion of the plugs attached to the harness; which is itself a fragile component. Additionally, the end of the harness which is located over the antenna tuner obstructs access to at least one of the major operating controls on the tuner. We request the possibility of interconnecting the various modules of the RS-18 according to the chassis connector method employed in the AS-3 be investigated with a goal of completely eliminating the necessity of an external harness.

c. As presently designed, the method of assembling the various modules is unduly cumbersome. The concept of portable and concealable component modules is negated somewhat by the extremely long screws used to attach the modules together. We recommend all RS-18 modules be attached to each other by a snap fastener arrangement similar to that presently used to fasten the antenna tuner to the remainder of the set.

d. In addition to the various technical shortcomings of the coder, CO-18, the following two complementary changes are considered desirable:

1. Elimination of the necessity for continually depressing the bias switch while encoding a message.

2. Addition of protection against accidental erasure of an encoded message.

e. A slight modification in the mechanism actuated by the coder's function switch could remove the ease by which the switch can accidentally be nudged into the "ERASE" position. This same modification would turn on the bias circuit at all times while the function switch is in the "write" position. We recommend the function switch mechanism be modified to a four position arrangement: ERASE - WRITE - STANDBY - TRANSMIT. The first two of these functions should require that the function switch be raised before

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movement from the standby position. The act of raising the switch would then activate the bias circuit continuously until the function switch was returned to the standby position.

f. Prior to the trip, we were informed the coder should always be stored in a panel down position otherwise the lubricant necessary to the mechanism may leak down onto the tape with resulting faulty operation. This condition must be rectified before operational usage of the coder can be made.

g. The antenna tuner in its present configuration is considered to be unacceptable for practical application to the Agency's requirements for the following reasons:

1. An antenna presenting a capacitive reactance must be used.
2. Crystals for use in the antenna calibration oscillator must be fundamental cuts. Since the operating range of the equipment extends to 26 mcs and the Crystal Laboratory reports the local preparation of the necessary crystals on a fundamental frequency above 20 mcs is quite impractical.
3. Meter indications of proper tuning and antenna lengths are, on occasion, ambiguous to the point of causing complete misadjustment of the matching circuit.
4. No "fail safe" provisions are incorporated in the tuner to indicate improper adjustment or operation. For example, the antenna tuning meter indicates excellent matching when no antenna is connected to the tuner.
5. The tuner contains no provisions for indicating the presence of RF power on the antenna while the transmitter is functioning.
6. Erection of the flexible antenna is a two-man assignment. The antenna wire reel has enough friction that the set must be securely anchored before the antenna can be pulled out; additionally, the rewind knob on the antenna reel often catches in the "lock" hole whether in the locked or unlocked position while attempts are being made to withdraw the antenna.
7. The interconnection cable harness, particularly the co-axial cords, cover the antenna tuning inductor knob.

h. We recommend the antenna tuner be completely redesigned to eliminate the above seven disadvantages. [redacted] has mentioned new circuitry 50X1 in which the antenna tuner might be completely contained in the transmitter module and employ the exciter stages as the signal source for antenna matching network adjustments. We suggest this approach be investigated along with the thought of using a pi output circuit to enable matching to both inductive and capacitive antennas.

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5. AS-3

- a. The IDY switch should be altered to enable positive contact in both circuits with less pressure.
- b. The cartridge should be modified to provide more positive rewind of the spools.
- c. The release lever on the cartridge would be more easily manipulated if releasing pressure could be applied more directly toward the left. As it exists, removal of the cartridge is a two handed action.
- d. A spring type latch should be added to the TAYLOR type fold out key. The purpose of the latch being to hold the key base down while the operating is keying. In its present configuration the operator must hold the key base down with his free hand.
- e. Modify the crystal socket and access hole with one capable of accepting FT-243 holders.
- f. The case of the coder should be stamped in such a manner as to allow greater clearance around the function keys. The dash button, particularly, is often not operated properly due to the operator's finger hitting the coder's case.
- g. For operator convenience it is recommended the antenna and ground terminal block be mounted in the same location but rotated in such a manner that the leads enter the block through the top of the transmitter instead of the side. Upon repositioning of the block, the buttons should not protrude beyond the transmitters' case.
- h. The cartridge reels should be marked in such a manner as to readily indicate when they are in the fully rewound position.
- i. The overall mechanical rigidity of the AT-3 does not appear to be very good. In particular, the cartridge case should be strengthened.
- j. We recommend a cover arrangement be added to the AT-3 to prevent small items from falling into the interior portions under the cartridge socket.
- k. We understand the cartridge assembly has already been modified to eliminate the failure of the erase function; the new version will be checked during the next test series.

6. KE-9

The KE-9 keyers, both types A and B, have been previously evaluated by this Staff and discussed in a memorandum to Chief, OC-E (TTT-M-9-179) dated 12 March 59. The test results coincided with the previous results obtained. 50X1

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7. Description of the tests conducted involving the RS-18 field equipment and the base equipment both before and after the field exercise are adequately covered in a memorandum to the files written by [] dated 30 April 1959. 50X1

8. During the field test, the [] was observed to be well located and equipped to be further outfitted with a modest facility for future medium distance equipment transmission tests. This idea will be investigated and presented as a formal proposal at a later date. 50X1

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